66441 **Structural Mechanics** **T P C**
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AIMS:

- To enable to apply the knowledge of scientific principles to problems of mechanical nature.
- To develop an understanding of mechanical properties of materials.
- To assist in applying mathematical and geometrical calculations to the analysis of statically determinate beams.

SHORT DESCRIPTION

Mechanical properties of material; Laws of forces; Moment; Friction; Centroid and centre of gravity; Moment of inertia; Torsion on circular shaft; Shear force and bending moment.

DETAIL DESCRIPTION

Theory:

1.0 Understand the important aspects of mechanical properties of materials.

1.1 Mention the necessity to know about the mechanical properties of materials.

1.2 Define the following terms:

a. Stress, tensile stress, compressive stress, shear stress.
b. Strain, tensile strain, compressive strain, shear strain,
c. Hooke's law, modulus of elasticity and modulus of rigidity.

1.3 Explain stress-strain diagram of mild steel and concrete.

1.4 Define the following terms:

a. Elasticity, proportional limit, yield point, ultimate stress, breaking stress, working stress and factor of safety.
b. Strength, stiffness, toughness, ductility, malleability, brittleness, creep, fatigue failure, resilience, modulus of resilience, thermal stress in simple bar and poisons ratio.

1.5 Compute stress, strain, modulus of elasticity and modulus of rigidity.

1.6 Solve problems involving resilience, thermal stress and poisons ratio.

1.7 Compute stress develop in composite bar under tension and compression.

2. Understand the concept of laws of forces.

2.1 Explain the laws of forces.

2.2 Define the following terms:

Force, co-planar forces, non-coplanar forces, concurrent forces, non-concurrent forces, co-linear forces, parallel forces, laws of equilibrium of forces.

2.3 Mention the parallelogram laws of forces.

2.4 State the composition of forces and resolution of force.

2.5 Define component of force, rectangular component and resultant of forces.

2.6 Compute the resultant force-

a. Triangle of forces
b. Polygon of forces
c. Converse laws of triangle and polygon laws of forces graphically.

2.7 Calculate the resultant of forces: co-planar forces, concurrent forces, parallel forces and co-linear forces

2.8 Explain Lami's theorem.

2.9 Solve problems on Lami's theorem.

3. Understand the aspects of moment of forces.

3.1 Define the term moment (analytically and graphically).

3.2 Differentiate moment with force.

3.3 Explain Varigon's principle of moment.

3.4 Distinguish like and unlike parallel forces.
3.5 State the meaning of couple.
3.6 Mention the properties of couple.
3.7 Solve problems on moment of couple and moment of forces.
3.8 Solve problems on moment of like and unlike parallel forces.

4. Understand the concept of frictional forces.

4.1 State friction, static friction and dynamic friction.
4.2 Mention the laws of static friction and dynamic friction.
4.3 Explain angle of friction and co-efficient of friction.
4.4 Compute friction of a body on horizontal planes.
4.5 Compute friction of a body on inclined planes.
4.6 Compute frictional force acting on a ladder.

5. Understand the aspects of centroid and centre of gravity.

5.1 Define the terms: centroid and centre of gravity.
5.2 State the axis of symmetry and parallel axis.
5.3 Compute the centroid by the method of moment of the following sections:
a. rectangular b. triangular c. circular d. semi-circular
e. hollow f. I–shaped g. T–shaped h. L-shaped

5.4 Solve problem on centre of gravity of a composite parallelepiped body.

6. Understand the concept of moment of inertia.

6.1 State 1st and 2nd moment of area.
6.2 Explain the meaning of radius of gyration.
6.3 Mention the theorems of moment of inertia.
6.4 Compute the moment of inertia of plane area about any axis of the following sections:
a. rectangular b. triangular c. circulard. semi-circular
e. hollow f. I–shaped g. T –shapedh. L -shaped

7. Understand the aspects of torsion on solid and hollow circular shaft.

7.1 State the laws of motions.
7.2 Explain the term circular motion.
7.3 Define the terms: torsion and torsional stress.
7.4 Mention the fundamental assumptions of torsional stress.
7.5 Find the relation between torsional stress and strain.
7.6 Interpret the formulas relating to finding torque
7.7 Solve problems involvingtorsion.

8. Understand shear force (SF) and bending moment (BM).

8.1 Define the term `beam'.
8.2 List different types of beams.
8.3 Mention various types of load on beams.
8.4 Define shear force and bending moment.
8.5 Differentiate between shear force and bending moment.
8.6 Mention the sign conventions of shear force and bending moment.
8.7 List the characteristics of shear force and bending moment diagram.
8.8 Calculate and draw SF and BM diagram of cantilever beams with point load, distributed load and both.
8.9 Calculate and draw SF and BM diagram of simply supported beams with point load, distributed load and both.
8.10 Calculate and draw SF and BM diagram of simply supported overhanging beam with point load, distributed load and both.

PRACTICAL:

1. Perform compression test of a timber specimen.
2. Conduct tensile test of mild steel rod and draw stress-strain curve with test results.
3. Determine the percentage elongation of mild steel.
4. Determine the centroid of a composite area.
5. Determine the resultant of a force system graphically.
6. Show the resultant of forces by using force board.
7. Prove the Lami's theorem by using force board.
8. Practice to determine the co-efficient of friction of timber, concrete and mild steel.
9. Practice to determine reactions of a beam by using spring balance.

REFERENCE BOOKS:

1. Structural Mechanics - W Morgan and D TWilliams
2. Structural Mechanics - Singer / Popov
3. Mechanics of Materials - Philip Gustave Laurson and Williams Junkin Cox
4. Structural Mechanics - A. K. Upadhyay Published by SK Kateria & Sons, India.

Applied Mechanics - R.SKhurmi